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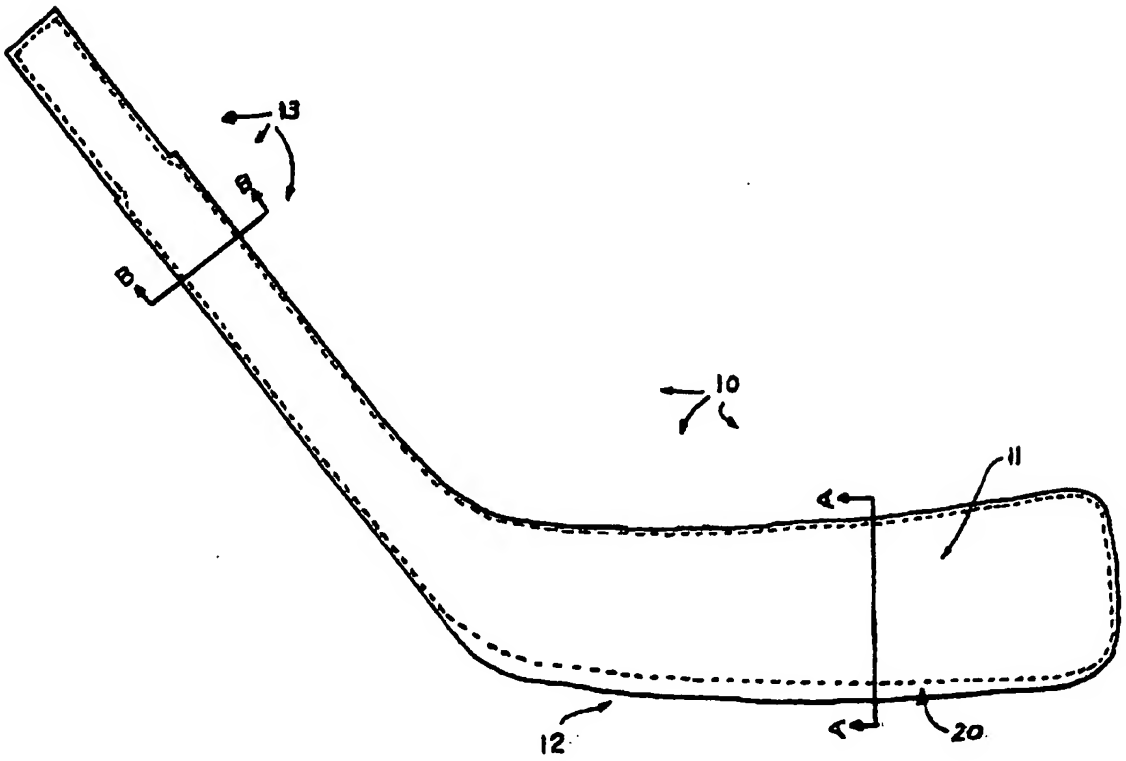
(54) **LAME DE RECHANGE DE BATON DE HOCKEY COMPOSITE ET METHODE CONNEXE**

(54) **COMPOSITE HOCKEY REPLACEMENT BLADE AND METHOD**



(57) The invention consists of a composite material hockey stick blade or stick itself suitable for use in both ice and off-ice hockey, and of a method for producing this type of blade. The blade combines the light weight, high breaking strength and high degree of stiffness needed for an ice hockey stick with the high wear resistance required for an off ice blade. The blade is made up of a wear resistant light weight wood core completely enclosed with continuous layers of fiber reinforced sheet or bulk moulding compound (SMC or BMC) to provide strength and stiffness to the blade.

ABSTRACT

The invention consists of a composite material hockey stick blade or stick itself suitable for use in both ice and off-ice hockey, and of a method for producing this type of blade. The blade combines the light weight, high breaking strength and high degree of stiffness needed for an ice hockey stick with the high wear resistance required for an off-ice blade. The blade is made up of a wear resistant light weight wood core completely enclosed with continuous layers of fiber reinforced sheet or bulk moulding compound (SMC or BMC) to provide strength and stiffness to the blade.

COMPOSITE HOCKEY REPLACEMENT BLADE AND METHOD

The present invention relates generally to hockey stick blades and their manufacturing, more particularly, to blades of fibre reinforced composite materials which are suitable for use in both ice and off-ice hockey.

BACKGROUND OF THE INVENTION

Traditionally, hockey sticks for use in ice hockey have been made of selected woods with careful attention paid to the quality and orientation of the wood grain for each of the stick components. Developments to improve the stiffness and strength of the stick have included improved quality control of the woods used, lamination of the shafts and the bonding of glass, carbon and other fibers to the exterior faces of the shaft and the blade. More recently, in an attempt to obtain strong, stiff sticks with reduced weight, hollow shafts of aluminum, composite and hybrids of aluminum and composite have been developed. Separate, replaceable wood blades are inserted into these shafts to form a stick.

Hockey sticks for off-ice (in-line and road) hockey typically use wear resistant acyrlonitrile butadiene styrene (ABS) blades. These blades are relatively heavy and flexible and are not considered suitable for ice hockey although they are extremely wear resistant and thus suitable for off-ice hockey.

All composite construction ice hockey blades can be stiffer, stronger and lighter than conventional wooden blades used in ice hockey, as well as road hockey blades made of ABS. For example, a composite blade made of a glass and graphite epoxy skinned polyurethane foam core can weigh as low as 160 grams and have stiffness as high as 75 kN/M while a high performance wood blade weighs 185 grams with a stiffness of 43 kN/M. The lighter, stiffer foam cored composite blade provides the hockey player with a tool that can generate greater shot accuracy. However, it is not sufficiently wear resistant for off-ice hockey usage.

A search of the patent literature relating to hockey sticks revealed a number of patents on blade technology. Most of these are not closely relevant to the teachings of the current invention in that they concern only improvements in standard laminated wood or fiberglass reinforced wood blades. These improvements include various tongue and groove connection mechanisms between the blade and a wooden shaft and morphology changes such as varying the degree of curvature of the blade.

Canadian Patent Application 2,099,853 discloses a method for manufacturing a composite blade by injection molding while using a foaming agent mixed with the resin to make a foam core. It is clear from the claims that short fibers, rather than long and continuous fibers, are used in this process, being mixed with and injected into the mold with the resin. It is well established that short fiber reinforced composites have only a small percentage of the strength and stiffness of the long and continuous fiber reinforcements that are used in the current invention. The blade revealed by this application will have far inferior stiffness, strength, weight and wear resistance than the current invention. Further, the foam core employed is known to deteriorate under puck impacts and does not have the wear resistance required for off-ice hockey and therefore has not met commercial success.

Canadian Patent 1,063,747 discloses a composite reinforced blade structure for a hockey stick. The composite blade consists of a foam core surrounded by a glass fiber reinforced plastic skin. The blade is formed in one piece, and the shaft is then inserted into this cavity and secured by an adhesive. The adhesive joint bonding the shaft to the blade will be much weaker than the joint of the present invention. The foam core is not wear resistant as is the core of the present invention and deteriorates under puck impacts, thus this blade would not be suitable for off-ice use and have therefore not met commercial success.

United States Patent 4,059,269 teaches a blade with the core consisting of a single piece of wear resistant material, such as ABS plastic, with the wear resistant core exposed below, above and to the front of the fiber reinforced resin layers which stiffen and strengthen the blade laterally.

Experience with the art has shown that blades of this kind are much heavier than the current invention because a solid ABS type core is used rather than light weight wood of the present invention. This blade would be suitable for off-ice hockey but would not possess the light weight, stiffness and joint strength required for a high performance ice hockey stick.

United States Patent 4,124,208 discloses a one piece stick with a foam filled honeycomb core and metal skins on both blade and shaft, which would be very expensive to produce, and thus it is not surprising that it has not been made commercially available.

United States Patent 5,333,857 teaches an all composite stick with a foam sandwich core blade. This is representative of a number of commercially available composite sticks which differ only in the specific foam core materials and fiber geometry specified in the patents or used in commercial production. This type of stick is expensive and suitable for ice hockey but is not sufficiently wear resistant to be suitable for off-ice hockey.

Experience reveals that 69% of all hockey stick failures occur in the blade (25%) or at the junction of the blade and the shaft (44%). Only 31% occur in the shaft itself. Experience has also shown that wood blades, whether reinforced with fiber or not, are not sufficiently wear resistant for off-ice hockey thus they have been superseded by ABS blades and fiber reinforced ABS blades. These blades tend to be much heavier than high performance blades used for ice hockey.

One composite blade design worth noting currently on the market is the Easton composite blade which is made by resin transfer molding (RTM) or by a prepeg process. The RTM process uses liquid resin resulting in a relatively costly process whereas the prepeg process uses relatively costly materials with a limited shelf life. The blades of this design therefore sell at a premium over wood blades, typically costing twice as much, and are not therefore meant to compete directly with wood blades.

Furthermore, market experience reveals that off-ice hockey blades are sold with both stiffness

and strength that are 30% lower than the typical high performance ice hockey blades. This is as a consequence of design compromises made to increase the wear resistance of the off-ice blades using current technology and lesser demands of the off-ice game i.e. lower puck weight and less shooting leverage.

SUMMARY OF THE INVENTION

The present invention overcomes the above shortcomings.

It is accordingly a primary objective of the present invention to provide a replacement blade or stick suitable for use in both ice hockey and off-ice hockey wherein the weight is in the lower range of the best ice-hockey blades, the stiffness is equal to or greater than the best fiber reinforced wood ice hockey blades, the wear resistance of the blade is equal to or greater than of the best ABS off-ice hockey blades and the breaking strength is equal to or greater than the best wood ice hockey blades.

It is a further object of the present invention to provide a composite blade for use with a hockey shaft which is made of wood or composite, or combination thereof, the blade characterized by its durability, weight and an increase in the strength and stiffness of the blade.

A major benefit of this invention is that the hosel is integrally joined to the composite blade under elevated temperature and pressure making a very strong bond in the area where over 44% of wooden stick failures occur.

In accordance with an object of the present invention there is provided a composite blade design that uses a low cost solid SMC or BMC material having a longer shelf life and using a light weight wood core thereby resulting in a low cost process and replacement blades meant to compete with wood blades. It should also be noted, that the replacement blade of the present invention results in a better performance blade for both ice and off-ice hockey for the same cost as compared to wood

blades.

In accordance with another object of the present invention there is provided a hockey replacement blade comprising: a light weight wood core, including a striking area and a hosel area; a reinforced moulding compound enclosing said wood core said moulding compound comprised of a combination of solid polymer compound with unidirectional and/or random fibrous oriented and positioned material; whereby the resulting replacement blade when combined with a hockey shaft makes a two-piece hockey stick suitable for both ice and off-ice hockey.

In accordance with still another object of the present invention there is provided a hockey stick comprising: a light weight wood core, including a striking area and a hosel area; a hockey shaft; and a reinforced moulding compound enclosing said wood core and said hockey shaft said moulding compound comprised of a combination of solid polymer compound with unidirectional and/or random fibrous oriented and positioned material; whereby the resulting one-piece hockey stick is suitable for both ice and off-ice hockey.

In accordance with yet still another object of the present invention there is provided a method of manufacturing a hockey replacement blade comprising the steps of: making a wood core, including a striking area and a hosel area; wrapping said wood core with a moulding compound comprised of a combinations of solid polymer compound with unidirectional and random fibrous oriented and positioned material; and subjecting said core to heat and pressure in a precise closed mould, thereby compression moulding a composite layer over said core; whereby a replacement blade is formed which when combined with a hockey shaft makes a two-piece hockey stick suitable for both ice and off-ice hockey.

In accordance with yet still another object of the present invention there is provided a method of manufacturing a hockey stick comprising the steps of: making a wood core, including a striking area and a hosel area; making a hockey shaft: wrapping said wood core and said hockey shaft with a moulding compound comprised of a combinations of solid polymer compound with unidirectional

and random fibrous oriented and positioned material; and subjecting said core and said hockey shaft to heat and pressure in a precise closed mould, thereby compression moulding a composite layer over said core and said hockey shaft; whereby a one-piece hockey stick is formed which is suitable for both ice and off-ice hockey.

Further objects and advantages of the present invention will be apparent from the following description, reference being made to the accompanying drawings wherein preferred embodiments of the invention are clearly shown.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further understood from the following description with reference to the drawings in which:

Figure 1 is a side view of a preferred embodiment of the invention;

Figure 2 is a cross-sectional view along lines A-A of Figure 1; and

Figure 3 is a cross-sectional view along lines B-B of Figure 1 in accordance with the present invention;

DETAILED DESCRIPTION OF THE DRAWINGS

Generally illustrated in Figure 1, a hockey blade 10 is comprised of a light weight wood core 11, possibly made of aspen, poplar or balsa, or other similar light weight woods, said core 11 including a striking area 12 and a hosel area 13, for combining said blade 10 with a hockey stick shaft made of wood or composite, or combinations thereof. The hosel area 13 will be sized to fit the geometry of the shaft such that the desired finished hockey stick is obtained. Methods of attaching the hosel 13 to the shaft will be known to those skilled in the art.

The preferred embodiment is the forming of a hockey replacement blade 10 comprising the

steps of making a lightweight wood core 11, wrapping the core 11 with an outer continuous layers of solid polymer unidirectional and random fibrous oriented and positioned reinforced sheet moulding compound 20 (SMC) or bulk moulding compound (BMC) thereby completely enclosing the striking area 12 and the hosel area 13 and subjecting said areas 12 and 13 to heat, between 270-300°F, and pressure, between 200-1000psi, in a precise closed mould thereby compression moulding a composite layer 20 over the entire light weight wood core 11.

The composite material used in the process is preferably solid toughened vinyl ester resin with long glass fibers with approximately 63% glass content and/or continuous glass fiber or other fibrous materials such as graphite or aramid.

This will provide for a hockey blade 10 having the required strength, stiffness and weight therefore making for a blade 10 suitable for both ice and off-ice hockey.

Referring to Figure 2, there is shown a light weight wood core 11 with a composite layer 20 over said core 11. It should be noted that a thicker layer of composite material may be present at the bottom 21 of the core 11 as compared to the top 22 in order to further prevent early wearing out of said core 11 due to contact with off-ice play surfaces, such as asphalt or cement, which are known to be more demanding on the bottom 21 of the core 11.

Referring to 3, there is shown a cross sectional view of the hosel area 13 whereby the wood core 11 is wrapped in a moulding compound, the composite layer, 20. It should be noted that a thicker layer of composite could be present at the major hosel faces 23 to further strengthen the hosel 13 on the faces of greater stress.

Once the moulding compound 20 is in place over the core 11 and has been moulded, it is then possible to attach said blade 10 via its hosel area 13 with a hockey shaft whereby a two-piece hockey stick with a composite blade is formed which is suitable for both ice and off-ice hockey.

It is also understood that it might be possible to attach the core 11 with a hockey shaft prior to wrapping said core 11 thereby making for a hockey stick which can then be completely wrapped, as one complete unit, with the moulding compound resulting in a one-piece hockey stick suitable for both ice and off-ice hockey.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes that come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A hockey replacement blade comprising:

(a) a wood core, including a striking area and a hosel area; and

(b) a reinforced moulding compound enclosing said wood core said moulding compound comprised of a combination of solid polymer compound with unidirectional and/or random fibrous oriented and positioned material;

whereby the resulting replacement blade when combined with a hockey shaft makes a two-piece hockey stick suitable for both ice and off-ice hockey.

2. The blade of claim 1 wherein the wood core is aspen, poplar or balsa.

3. The blade of claim 1 wherein the moulding compound is SMC or BMC.

4. A hockey stick comprising:

(a) a wood core, including a striking area and a hosel area;

(b) a hockey shaft; and

(c) a reinforced moulding compound enclosing said wood core and said hockey shaft said moulding compound comprised of a combination of solid polymer compound with unidirectional and/or random fibrous oriented and positioned material;

whereby the resulting one-piece hockey stick is suitable for both ice and off-ice hockey.

5. The hockey stick of claim 4 wherein the wood core is aspen, poplar or balsa.

6. The hockey stick of claim 4 wherein the hockey shaft is made of wood or composite or combinations thereof.

7. The hockey stick of claim 4 wherein the moulding compound is SMC or BMC.

8. A method of manufacturing a hockey replacement blade comprising the steps of:

(a) making a wood core, including a striking area and a hosel area;

(b) wrapping said wood core with a moulding compound comprised of a combination of solid polymer compound with unidirectional and/or random fibrous oriented and positioned material; and

(c) subjecting said core to heat and pressure in a precise closed mould, thereby compression moulding a composite layer over said core;

whereby a replacement blade is formed which when combined with a hockey shaft makes a two-piece hockey stick suitable for both ice and off-ice hockey.

9. A method according to claim 8 wherein the wood core is aspen, poplar or balsa.

10. A method according to claim 8 wherein the moulding compound is SMC or BMC.

11. A method according to claim 8 wherein the heat is between 270-300°F.

12. A method according to claim 8 wherein the pressure is between 200-1000psi.

13. A method of manufacturing a hockey stick comprising the steps of:

(a) making a wood core, including a striking area and a hosel area;

(b) making a hockey shaft:

(c) wrapping said wood core and said hockey shaft with a moulding compound comprised of a combination of solid polymer compound with unidirectional and/or random fibrous oriented and positioned material; and

(d) subjecting said core and said hockey shaft to heat and pressure in a precise closed mould, thereby compression moulding a composite layer over said core and said hockey shaft;

whereby a one-piece hockey stick is formed which is suitable for both ice and off-ice hockey.

14. A method according to claim 13 wherein the wood core is aspen, poplar or balsa.

15. A method according to claim 13 wherein the hockey shaft is made of wood or composite or combinations thereof.

16. A method according to claim 13 wherein the moulding compound is SMC or BMC.

17. A method according to claim 13 wherein the heat is between 270-300°F.

18. A method according to claim 13 wherein the pressure is between 200-1000psi.

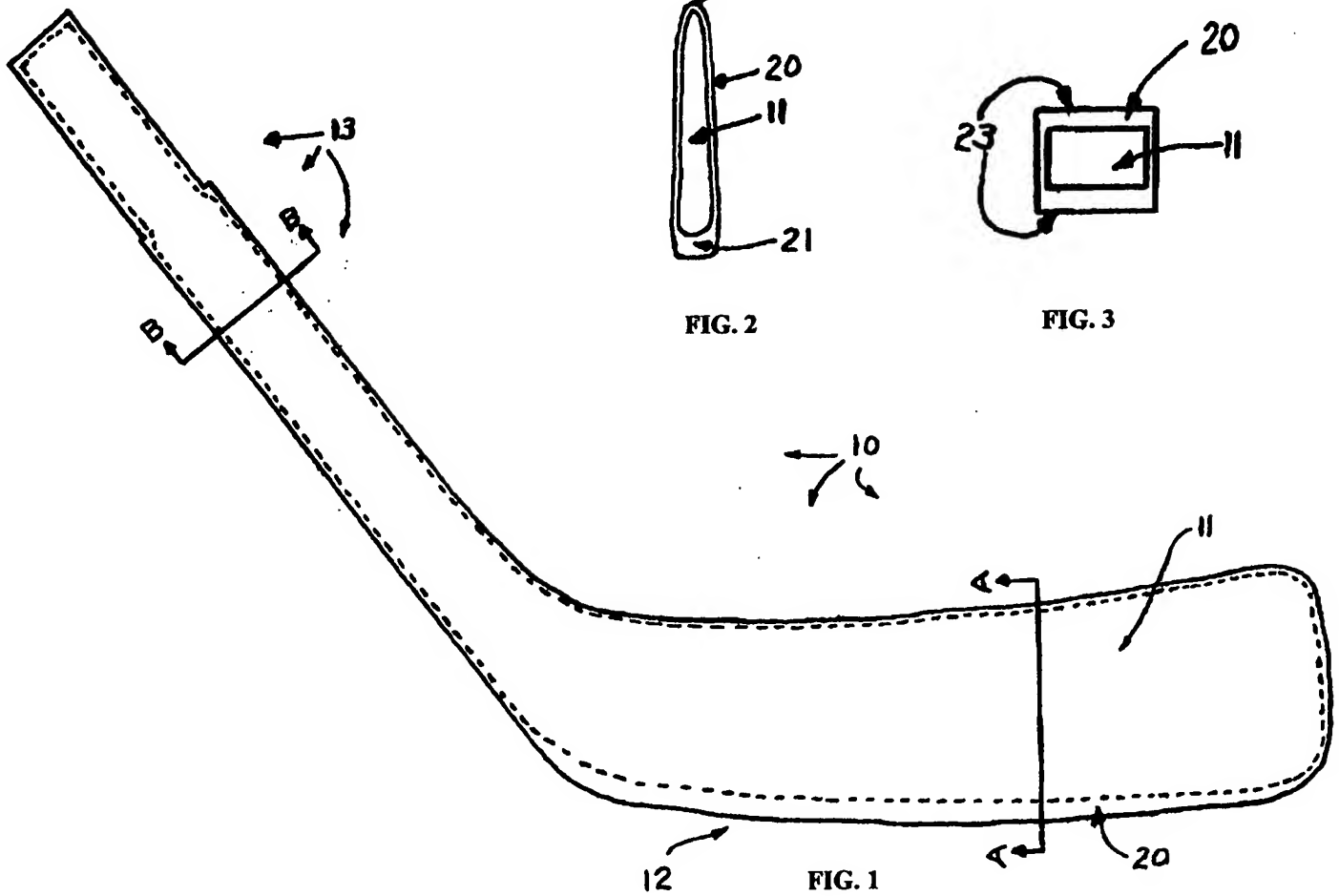
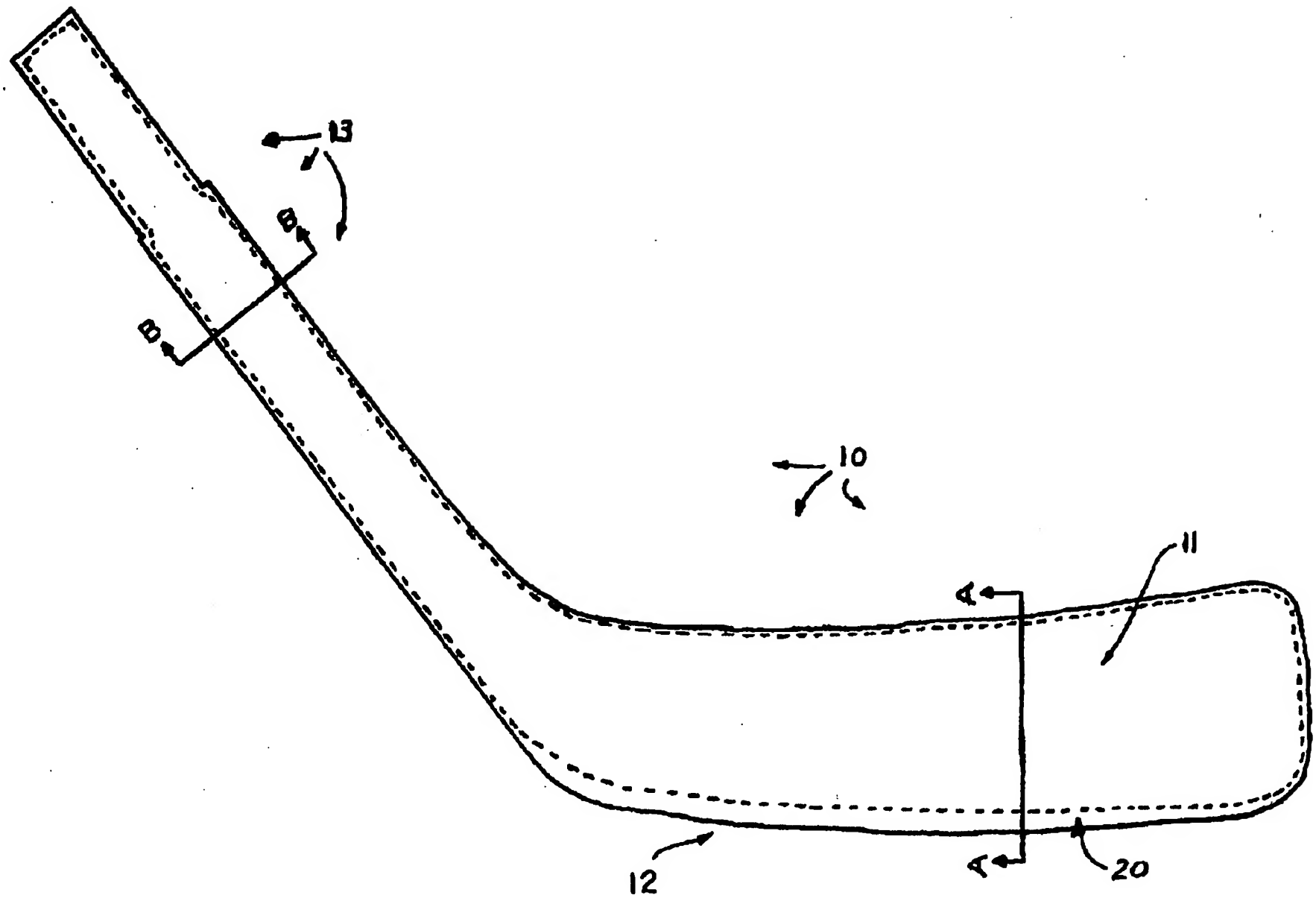


FIG. 1

FIG. 2

FIG. 3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